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Structural adjustment programmes and the coffee sector in Uganda, 1981–1987

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Update

The cut-off point for this paper is May 1989. Since then the ICO quota has been suspended. This has led to a dramatic fall in the international price of coffee from US$ 2.00 to around US$ 0.80 per kg of robusta. The projections at the beginning of Section III of this paper are, therefore, outdated.

However, improving the *efficiency of the marketing system* is even more important now. In order to still realize some exports earnings from coffee, Uganda must reduce marketing costs as far as possible in the short-run.

In the long-run, structural adjustment policies should aim at diversifying exports and reducing the relative importance of coffee. But the most likely new exports are dried foods (maize, beans, groundnuts, soybean, millet, simsim) and fresh horticultural produce. These commodities are perishable and deteriorate far more rapidly than coffee. The marketing system, therefore, must be even more efficient to handle these new exports.

Also to allow for a rapid reallocation of resources to new exports, *producer prices* must be renumerative, at least higher in real terms than what coffee farmers have been receiving.

The shilling has been devalued from USh 200 to USh 470 per US$, partly to raise government revenue and to encourage diversification of exports.

Without an improvement in producer prices and marketing efficiency, however, devaluation will not be sufficient to achieve the stated objectives of structural adjustment. The main conclusions of the paper, therefore, are still valid.

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3. *Proceedings of the Coffee Processors Seminar* at Mukono, July 1988, organized by C. Wagidoso, Uganda Ministry of Cooperatives and Marketing.

4. Proceedings of the Workshop on Management of the Ugandan Economy—Agenda for Reform, 26–29 April 1989, organized by the Uganda Economic Association at which I presented a paper on "Crop Finance and Resource Mobilization: the Need for Restructuring".

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Abstract

The purpose of this study was to investigate the effects of structural adjustment policies on the supply conditions of coffee, Uganda's major export, which accounts for over 90% of foreign exchange earnings and about 50% of tax revenue. Because of a lack of quantitative data, it was impossible to compute the price elasticity of supply related to higher producer prices of coffee made possible by the structural adjustment policies, especially devaluation. Instead, qualitative information was gathered on own producer price of coffee, smuggling, efficiency of the marketing system, the opportunity cost of competing crops, and the prospects of introducing new technology/and farming systems.

The qualitative evidence suggests that the supply of coffee is *price inelastic:* the lack of price response is due to adverse pricing policy that taxes the farmer excessively and the inefficiencies of the marketing system that cause delay in paying the same farmer. Given this conclusion, Uganda has to devalue by a very large percentage in order to effect an increase in coffee exports; she cannot afford to forego the required large reduction in export duty to increase the producer's price, if she were not to devalue.

Whereas devaluation might be necessary to stimulate exports, by itself it is not sufficient: an optimal pricing policy administered through an efficient marketing system, taxation reform and exports diversification, all appear equally necessary components of a successful adjustment programme. Without these components, the potential benefits of devaluation are quickly eroded by inflation and further devaluation is increasingly resisted by government as the benefits dwindle.

I. Introduction: Structural adjustment and the coffee sector

The main instrument of structural adjustment has been a gradual depreciation of the exchange rate since June 1981. Depreciation was intended to improve the comparative advantage of producing exportables. Since coffee accounts for over 90% of Uganda's foreign exchange earnings, this paper concentrates on the effects of exchange rate adjustments on coffee exports.

Depreciation was intended to increase the price of coffee in local currency: part of this increase was to be passed on to the farmer in the form of a higher producer price to induce him to increase coffee output from the field, and to divert previously smuggled coffee into official export channels. The ultimate objective was to increase foreign exchange earnings, a major constraint on restructuring the economy.

A related objective was to redistribute income in favour of the farmer by raising rural purchasing power as the price of coffee rose relative to the price of consumables.

A third objective was to find a non-inflationary source of government revenue: as the price of coffee rose in local currency, government was to collect part of the increase in export duty and use it to reduce the proportion of the budgetary deficit financed from the banking system, which is inflationary.

The purpose of this paper is to investigate the change in the supply conditions of coffee due to exchange rate adjustment and related policies, i.e. the extent to which the objectives stated above have been realized since 1981.

The paper is organized as follows. Section II outlines the methodology for estimating the price elasticity of coffee supply under Uganda's data shortcomings. Section III provides a qualitative analysis of the short-run and long-run determinants of coffee supply. Section IV investigates the policy options, exchange rate adjustment or tax reform, for raising the producer price of coffee in order to effect the desired change in export quantity. Section V discusses three other important considerations: the domestic resource cost of coffee as an index of comparative advantage; the Sebastian Edwards hypotheses on the problems of exchange rate policy in a single-export economy; and the current national crisis of crop finance. Section VI summarizes the findings.

II. Methodology for estimating coffee-supply elasticities and Uganda's data limitations

Since coffee is a perennial crop, the supply models assume that acreage under coffee-yielding trees is fixed, at least in the short-run, and might remain fixed even in the long-run if coffee is grown in densely populated areas where land is scarce (Maitha, 1974).

The models concentrate on the determinants of changes in output per hectare or land productivity, to which variation in labour can be applied in the short-run; and technology improvement, purchased inputs and tree replanting can be applied in the long-run. The standard equation of the models takes the form:

$$(1)\ \log (Q/X)\, t = ao + a_1 \log P_i - a_2 \log P_2 - a_3 \log Z_{t-1} - a_4 \log \frac{(L)}{r}$$

- (Q/X) = output per hectare
- a_0 = the constant reflecting past historical influences and weather
- a_1 = the own producer price elasticity of supply, the main target of exchange rate adjustment
- a_2 = the price elasticity of the substitute crop competing with coffee for the same productive resources: this is negative, an increase in the price of the substitute crop reduces the supply of coffee
- Z_{t-1} = stocks of the previous year's output, which vary with marketing efficiency, e.g. paying farmers cash on delivering the crop, and rapid stock turnover by the processing and marketing system
- a_3 = the stock elasticity, which is negative since the build-up of stocks is a disincentive to increasing current production
- L/r = the land-rental ratio
- a_4 = the elasticity with respect to the land-rental ratio, which is negative since an increase in the land-rental ratio reduces profitability.[1]

Uganda's data limitations

The total production of coffee (Qt) per year in Uganda is unknown since there are no figures on production or area planted, the (X) variable. The last agricultural census was in 1965, and the next one is planned for 1991. The figures in Table A.1 are extrapolations.

The indicative figures from the Ministry of Agriculture in Table A.2 show that about 195,000 hectares are under robusta coffee, and 30,000 hectares under arabica. But as the notes to the table indicate, the figures are not very accurate.

For production, the figures on yield (Q/X) are unknown. The data in Table A.3 are on marketed output purchased by the Coffee Marketing Board, which is influenced by changes in stocks and diversion from smuggling.

Data on the real producer price P_i (equal to the nominal producer price, deflated by the Kampala cost of living index, low-income group) are reported in Table A.4 for each type of coffee. The figures for P_2, the real producer price for bananas, the competing crop, are also similarly deflated and reported in Table A.3, column (4). But data on $\frac{(L)}{r}$ are not available.

Given the lack of data on the dependent variable, and on the third and fourth independent variables, it is not possible to estimate the price elasticity of supply for Uganda's coffee in any meaningful way.[2]

Illustrative data from other countries

Table 1 provides illustrative estimates of price elasticities of supply from neighbouring Kenya and Africa. The range of short-run elasticities is between 0.12 and 0.70; whereas that of long-run elasticities is between 0.44 and 1.5. Taking these estimates as a guide, we shall assume that 0.10–2.00 covers the feasible range of price elasticities that would have been obtained had data been available in Uganda: we shall use the values within this range for policy analysis in Section IV, below.

Table 1. A comparison of producer response to prices of coffee in various African countries

Country	Period	Author	Year	Short-run elasticity	Long-run elastisticity
(1)	(2)	(3)	(4)	(5)	(6)
Kenya	1946–1964	Maitha	1970	0.64*	1.33
Kenya (estates)	1946–1964	Maitha	1970	0.66*	1.38
Kenya (small-holder)	1946–1964	Maitha	1970	0.64*	1.48
Kenya	1946–1964	Ford	1971	-	1.07
Kenya (estate)	1946–1964	Ford	1971	-	1.18
Kenya (small-holder)	1946–1964	Ford	1971	-	1.15
Africa	1947–1963	devries	1975	0.12*	0.44

Source: Bond, 1983.

III. The determinants of supply response

Before examining what makes coffee output respond to price changes, it is useful to determine first whether the pontential increase in output can be sold at remunerative international prices.

Trends in international prices

Table 2 shows the recent trends in the unit value of Uganda's coffee f.o.b. Mombasa, and the international prices for both coffee and competing export crops.

Table 2 Trends in international prices of Uganda's exports (US$ per kg)

				Competing crops		
	(1)	(2)	(3)	(4)	(5)	(6)
	Unit value index, coffee	Robusta coffee	Arabica coffee	Tea	Cotton (medium staple)	Maize
1980	100	3.54	3.44	2.90	2.07	0.17
1981	61	2.27	2.19	2.02	1.85	0.18
1982	65	2.44	2.29	1.95	1.61	0.16
1983	77	2.72	2.97	2.32	1.85	0.15
1984	87	3.04	3.17	3.46	1.78	0.15
1985	74	2.60	3.21	1.98	1.32	0.14
1986	91	3.20	4.40	1.93	1.06	0.12
1987	66	2.20	2.57	1.88	1.43	0.11[1]
Nov. 1988	"	2.00	2.95			

Sources: a. Republic of Uganda, Background to the Budget, 1988–1989.
b. Agricultural Secretariat, Bank of Uganda. The 1980 and 1985–1987 figures are from the London market, the rest are from the source in Note 3.
c. International Monetary Fund, *Primary Commodities: Market Developments and Outlook* (Commodity Division, Research Department, Washington D.C., May 1987).

Although the unit value index, column (1), has declined since 1980, compared to other exports (columns 4–6), coffee still fetches the highest international price per kilogram (columns 2–3).

Projections in this paper will be based on the assumption that the world price will stay around US$ 2.00 per kg. This is not far from the recent low price of US$ 1.9 per kg. At this price, coffee still compares favourably with the other exports.

The market for coffee

Assuming that Uganda resumes all aggressive marketing policy to regain her 5% share in the international quota market, which she held in the 1970s, and also to export to non-quota markets up to 30,360 kg. which she exported in 1972, the following export quantities have been projected as feasible, up to the maximum in the last row of Table 3.

Table 3 Projected exports of clean coffee to quota and non-quota markets

Marketing season	Uganda's share in the quota (%) (1)	Projected exports to quota markets (tons) (2)	Projected exports to non-quota markets (tons) (3)	Total exports (tons) (4)
1987/88	4.1	142,680	18,000	160,680
1988/89	4.2	149,640	18,900	168,540
1989/90	4.5	159,300	19,860	179,160
1990/91	4.7	169,200	20,880	190,080
Maximum	5.0	174,000	30,360	204,360

Source: Agricultural Policy Committee, *Report on Producer Prices for Export Crops During 1988/89* (June 1988), Kampala, Agricultural Secretariat, Bank of Uganda.

Recent estimates by the Ministry of Agriculture, in metric tons, are:

	Robusta	*Arabica*	*Total*
1989/90	179,262	25,911	205,253
1990/91	206,190	29,890	236,253

Most analysts regard these estimates as too optimistic, given the supply and marketing problems to be discussed. We, therefore, retained the conservative estimates extrapolated from the Agricultural Secretariat in Table 3.

Compared to current exports of 148,200 tons in 1987, Uganda could increase her exports by 56,160 tons, which represents a 38% increase in export volume. At US$ 2 per kg the 56,160 tons would earn an extra US$ 112.32 million, which is a 35% increase in the value of exports over those of 1987.

For the policy analysis below, we shall use 56,160 tons as the working figure for a feasible increase in exports. Given that this figure represents close to a

40% increase in export volume, and around 35% in exports earnings, it is important to examine critically the factors determining coffee supply since a realization of the 56,160 tons goal within five years could greatly alleviate Uganda's foreign exchange shortage.

The determinants of coffee supply: Short-run factors

In the short-run, 1–2 years when acreage is fixed, changes in exportable output from exchange rate adjustment depend upon several factors: own producer price, diversion from smuggling into official channels, efficiency of the marketing system, and the reallocation of labour from competing crops.

(a) The own producer price (P_1)

Table 4 shows the current pricing structure, i.e. the share in the international price per kilogram of clean coffee by each claimant. When the absolute value of the coffee price is raised in domestic currency by depreciation, only a small part of the increase is passed on to the farmer, i.e. no more than 37%.

Table 4 Pricing structure of coffee

Claimant	Share in the world price of 1 kg. clean robusta coffee (percent)		
	1987/88	1988/89	1989/90
Farmer's share	37.0	36.0	28.51
Primary society collection costs	0.6	0.6	
Processing costs	6.7	8.4	
Export and marketing costs	12.7	10.8	
Government export duty	43.0	44.2	
	100.0	100.0	

Source: Agricultural Secretariat, Bank of Uganda.

Notes: (a) The nominal producer price of USh 60 per kg of robusta kiboko was set when the exchange rate was USh 150 per US$. When the shilling was devalued further to Sh165 and Sh200, the price per kilogram of coffee was not changed from Sh60. These two devaluations eroded the farmer's share to 28.5 percent per kg. of clean robusta.

(b) When the international price of coffee falls, the processing and marketing co-operatives and the CMB are paid the same amont of Uganda shs. The government reduces its share. This neither benefits the farmer nor the government. It simply encourages inefficiency of the marketing system. (See also section (c) below).

The proportion passed on in nominal terms appears large, as columns (1) and (2) of Table A.5 in Appendix A suggest; but in real terms the proportions are small as they are eroded by the rapid rate of inflation, as illustrated in Table A. 4. In fact, real producer prices have not risen systematically despite repeated devaluations.

Producer prices are adjusted infrequently, at most twice a year. The farmer, however, purchases his requirements from the open market where prices adjust continuously with the rate of inflation, reducing his purchasing power, as illustrated in Table 5. This erosion of purchasing power, redistributes income against the farmer, contrary to the stated objectives of the structural adjustment programmes.

Table 5 Change in farmers' purchasing power of a basket of commodities from a kilogram of robusta kiboko coffee

Commodities	1972	1981	May 1987	Oct. 1987	Jan. 1988	May 1988
Salt (kg)	1.21	0.28	0.96	0.60	0.80	0.20
Sugar (kg)	0.59	0.09	0.40	0.24	0.15	0.07
Soap (bar)	0.24	0.04	0.24	0.24	0.48	0.03
Paraffin (litre)	1.98	0.65	1.20	0.80	1.45	0.14
Cloth (metre)	0.44	0.11	0.24	0.03	0.05	0.03

Source: Agricultural Policy Committee, Report on producer prices for export crops during 1988/89. Kampala, Agricultural Secretariat, Bank of Uganda.

Note: There has been no regaining of the 1972 terms of trade. Improvements in the purchasing power of coffee in terms of paraffin during May 1987 and January 1988 are due to the fact that paraffin prices were temporarily fixed and paraffin rationed. Other higher figures in May 1987 reflect currency reform, whose effect was already eroded by May 1988.

Purchasing power is further eroded because the farmers are often paid the fixed prices late,[3] sometimes up to one year later, because of mismanagement of crop finance, to be discussed separately in Section V below.

Other countries have been paying the farmer a larger share of the world market price—up to 70 percent in Malawi, for example. In Tanzania, the farmer's share in the world price of a kilogram of clean coffee has been (in percentages):[4]

1966/67	1969/70	1975/76	1976/77	1984/85
73.0	85.5	72.0	46.1	65.6

The minimum share of 46.1 percent is still well above the Uganda maximum of 37.0% in Table 4. The farmer's share in the world price, therefore, needs increasing. The absolute value of the farmer's price also needs frequent adjustment to compensate him for inflation, otherwise he will have no incentive to increase coffee production.

(b) Official-smuggling dual market channels and the price elasticity of supply

The theory behind equation (1) assumes that all coffee is marketed through official channels. In Uganda, however, smuggling is frequent. Although the exact quantities are not known, the dramatic increases in official figures of marketed output in 1982 in Table A.3, for example, are attributed by analysts to three factors: the deccumulation of stocks in response to higher producer prices; paying cash to the farmer on delivering the crop; and diversion of previously smuggled coffee into official channels.[5]

If one were to compute the price elasticity of supply a1 from equation (1), the value of this elasticity would be exaggerated because of quantities diverted from smuggling. This would understate the required devaluation (and increase in producer price) to effect a desired increase in quantity, were all the quantity to come from increased output alone.[6]

To achieve the objectives of structural adjustment programmes, smuggling should be stamped out: it reduces foreign exchange earnings accruing to official channels. But, in practice, this has proved difficult in Uganda.

Part of the motive for smuggling is overvaluation of the exchange rate which makes border prices more attractive. When this is combined with late payment to the farmer of a small share of the world market price, the incentive to smuggle is strong. For example, in 1987, the Zairean border prices for robusta and arabica clean were the equivalent of USh 100 and USh 140, respectively, while the prices were only USh 48 and USh 50 respectively, in Uganda. Recently the government has resorted to strictly policing the borders to stamp out this type of smuggling instead of adjusting the exchange rate.

However, part of the motive for smuggling also derives from taxation policy. Some smuggling is done through official channels by under-invoicing coffee exports, loading unrecorded bags, and bribing border officials. The foreign exchange earned is used to smuggle back highly taxed imports, e.g. cigarettes and alcohol.[7] Both realignment of Uganda's exchange rate with that of her neighbours, and more efficient tax collection at the borders, are needed to combat smuggling.

(c) Efficiency of the marketing system and the movement of stocks

The stock elasticity a_3 measures the change in output with respect to variation in stocks throughout the marketing system. A build-up of stocks discourages current production and increases marketing costs: a_3 has a negative sign in equation (1).

Stocks appear at the three levels of the inefficient marketing system: at farm level; at primary processing centres for rough-hulled coffee; and at secondary processing and final marketing.

Processing and marketing costs make up up to 20 percent of the international price per kilogram of clean coffee. Improvements in the efficiency of the system

would not only increase deliveries to the world market but would also reduce this figure leaving the balance to be passed on to the farmer. (see also note 2 to Table 4).

Buying centres. Presently, coffee is bought from the farmer, either by private buyers or by primary co-operative societies, at a collection margin of 0.6 percent of the international price per kilogram of clean coffee.

Buying by co-operatives is slow because of inadequate crop finance;[8] this *reduces* marketable output from a given crop season. The farmers stock the coffee on the farms under poor conditions waiting to deliver it when cash is available.

Private buyers pay cash on delivery, but at a discount of 2 kg (non-paid) per 60 kg bag of kiboko. Approximately 40 percent of private buyers, who do not have processing facilities, stock the coffee until the next buying season: when the producer price is raised, they deccumulate the stocks on to the market for trade gains. This leakage *reduces* marketable output in a given crop season and leads to deterioration in quality.

Processing centres: Primary processing. As illustrated in Table A.6, the structure of the processing industry is covered by three types of primary processors of rough-hulled coffee: 58 percent of the factories are privately owned, 26 percent are owned by primary societies and 16 percent by unions within the co-operative movement.

In the current 1989/90 season the co-operatives are processing 30 percent of the crop, while private processors are handling 70 percent. This is a recent change because private processors handle crop-finance more efficiently and also pay the farmers cash on delivery.[9]

Processing takes 6–8 percent of the international price per kilogram of clean coffee. There are two inefficiencies, which if rectified could reduce this figure and increase the farmer's share: under-utilization of capacity and low stock turnover.

In 1987, Uganda had 280 factories with 509 hullers, located as in Table A.7. Assuming that 1,000 tons are processed by a fully utilized huller, and given that all factories in Table A.7 delivered 145,440 tons of processed coffee to the Coffee Marketing Board (CMB), the average is 520 tons per factory, or 50 percent capacity utilization. This average gives a better picture of the reality, however: when columns (7) and (8) are taken into account, 70% of the factories delivered less than 500 tons to CMB, and 17% of the factories delivered less than 100 tons.

Under-utilization of processing capacity leads to high unit costs. The factors leading to low capacity utilization include frequent power failures, dilapidated processing equipment, and licensing of new factories in areas with excess capacity (see note on Rakai, Bushenyi and Rukungiri districts, Table A.7).

In some cases, excess stocking is due to dilapidated processing equipment which breaks down frequently. An extreme example is the Bugishu Mill in

Mbale (a region with few factories; see note in Table A.7). This mill stocks 5,000 tons of semi-processed coffee for up to eight months on a wet dusty floor: quality deteriorates, and marketable output in the season is reduced.

Secondary processing and marketing. Although there are four large union factories with secondary processing facilities (Busoga, East Mengo, Wamala, and West Mengo), the Coffee Marketing Board is the sole government-owned monopoly exporter of coffee, for which services the Board claims about 12 percent of the international price.

When the CMB realizes a surplus, it is turned over to government, but when it realizes a deficit government covers it. This gives the CMB no incentive to increase efficiency.

The CMB has insufficient trucks to deliver coffee to Mombasa and Dar es Salaam resulting in delayed shipments; it is a poor collector of sales revenue from government departments which barter coffee; its quality control system is poor; and it often takes up to four months to pay processors from the time they deliver the crop.[10] All the inefficiencies reduce marketable output and increase stocks and marketing costs.

Summary on marketing efficiency: The marketing system is inefficient at all levels, especially the parastatal-like co-operatives and the CMB. The inefficiency reduces marketable output per season, builds up stocks at each of the three levels, and increases marketing costs.

(d) The substitutability of coffee and bananas and the re-allocation of labour

Bananas are the main competing crop in all three coffee-farming systems. If labour is tripled on a fixed acreage of land, it can raise yields from 600 kg to 1,400 kg per hectare for robusta, and from an average of 500 kg to 750 kg per hectare for arabica (see data on traditional I and traditional II farming systems for robusta, and traditional I and improved III farming systems for arabica in Table 6).

The higher yields come from pruning, mulching, controlling soil erosion, better weeding, and more careful harvesting and sorting. Assuming that 1 kg kiboko equals 0.52 kg of clean coffee, Table 7 shows the change in total marketable output from 68,390 to 152,427 tons of clean coffee.

Table 6 Comparison of farming systems returns

Crop and farming system [a]	Yield (kg/ha)	Returns (USh/ha)	Returns (USh/man-day)
(1)	(2)	(3)	(4)
Robusta			
Traditional I	600	17,000	171
Traditional II	1,400	39,940	138
Improved III	2,500	25,000	68[b]
Advanced IV	5,000	91,000	152
Western arabica			
Traditional I	400	9,270	66
Improved III	600	9,939	49[c]
Eastern arabica			
Traditional I	600	32,640	187
Improved III	900	43,714	174
Bananas			
Traditional I	5,000 tons/ha	53,670	228
Improved/advances III and IV	15,000 tons/ha	111,720	422[d]

Source: Agricultural Secretariat, Bank of Uganda, Coffee Farming Systems Development Report, August 1988.

Notes: a. The farming systems are defined as follows:

Traditional I: Semi-abandoned shamba with hardly any inputs except harvesting labour. A large number of coffee farmers allocate labour like this currently.

Traditional II: Triple labour inputs for better weeding, mulching with grass, pruning, better harvesting and sorting; usually when there is cash payment on delivery, at a higher producer price.

Improved III: In addition to tripled labour, applied purchased inputs: fertilizers, insecticides, herbicides, etc.

Advanced IV: In addition to tripled labour and purchased inputs, replant with higher yielding varieties. The yield shown is after five years when the trees mature.

b. Despite the increase in yield, the return per hectare and per man-day are reduced because purchased inputs are scarce and intermittently supplied on the open market at high prices (usually diverted from donor agencies at fixed prices).

c. For arabica, the existing stock is so old that it does not pay to apply purchased inputs, or triple labour. "Improved" entails only spraying.

d. The application of purchased inputs and replanting occur simultaneously. At higher market prices, purchased inputs for coffee are most likely diverted to bananas, the leading competing crop for land and labour.

Table 7 Variation in output from re-allocation of labour to a fixed area of 190,000 ha robusta and 33,000 ha arabica (metric tons).

	Minimum yields (metric tons)					
	Traditional farming system I			Traditional farming system II		
	(1) Robusta	(2) Arabica	(3) Total	(4) Robusta	(5) Arabica	(6) Total
Kiboko	115,020	16,500	131,520	268,380	24,750	293,130
Clean	–	–	68,390	–	–	152,427

Source: Calculated from Tables A.1 and 6.
Note: One kilogram of kiboko = 0.52 kg of clean coffee.

The figures in Table 7 illustrate the current dilemma facing the coffee sector. The medium yield of 152,427 tons is about equal to the 1985 marketed output of 152,000 tons. To keep up the current exports volume, therefore, Uganda has to intensify her labour inputs into coffee.

But farm labour is not free, it has a positive opportunity cost in terms of the returns it can earn from the competing crop, bananas.

The returns for bananas per hectare in the traditional farming system I are USh 53,670, compared to USh 39,944 per hectare of robusta coffee from intensified labour in farming system II (Table 6). The returns for Arabica coffee are even lower. In terms of average productivity per man-day, the returns from bananas are USh 288 in farming system I while those from robusta in farming system II are only USh 138.

The administered price of coffee, therefore, which is too low, paid late, and only adjusted upwards infrequently, offers little incentive to re-allocate labour from bananas. This is so despite the fact that the real price of bananas per kilogram is lower than that of coffee, and is also declining due to inflation (compare columns (2) and (3) with column (4) of Table A.4). The yields for bananas are higher, and there is an added advantage that the farmer is paid cash on delivery.

Returning to Table 7, if coffee trees are neglected, marketable output can drop to 68,390 tons, even when the trees are not uprooted. Currently many fields are semi-abandoned, utilizing minimum labour for harvesting poorly weeded, unpruned and diseased trees growing on eroded soil. If this trend continues, within two years output could shrink by as much as 46 percent from that marketed in 1987. *This is the seriously threatened state of the coffee sector* in the short-run, which policy makers fail to realize: because coffee is a perennial crop, they think that high yields are perpetual.

Tables 6 and 8 might overstate the case today, as the price of coffee may rise beyond that of May 1988, upon which the tables in this paper are based. However, when the price of coffee goes up, so does the price of bananas, and the prices of inputs: the crisis facing the coffee sector remains. Only when the

pricing system is changed to one of parity, as illustrated in Table 8, columns (3) and (5), can coffee compete with bananas for labour.

Table 8. Comparison of cropping systems returns, May 1988 (USh)

Farming system[a]	Per ha (USh '000)			Perman-day (Ushs)	
	Economic[c] (1)	Financial[d] (2)	Parity (3)	Financial (4)	Parity (5)
Robusta traditional I	13.3	35.2	40.2	218	249
Robusta traditional II	23.9	40.6	52.4	196	253
Robusta improved III	40.3	69.3	105.7	289	441
Robusta advanced IV	51.6	74.6	118.2	289	458
W. arabica traditional I	8.7	34.5	37.1	206	222
W. arabica improved coffee III[b]	10.2	34.6	68.9	195	220
W. arabica improved all crops III	16.4	68.7	84.1	361	441
E. arabica traditional I	16.6	36.6	43.1	218	257
E. arabica improved coffee III[b]	21.8	38.6	48.7	212	268
E. arabica improved all crops III	27.8	69.8	90.1	360	464

Source: Agricultural Secretariat, Bank of Uganda, Coffee Farming Systems Development Report, August. 1988.

Notes:

a. The farming systems I–IV are defined in the text and in Note a to Table 6.

b. It does not pay to adopt farming system IV for arabica; the resulting returns, after the loss of 18 months' output before the new crop comes into harvest, are marginal.

c. The returns are calculated as the financial returns plus the valuation of labour at its opportunity cost in alternative employment, e.g. growing bananas in this case.

d. The farmer pays for the inputs at market prices and receives the fixed government price ruling in mid-1988, without including the cost of labour.

e. The net returns are calculated by paying for the cost of inputs at world market prices and selling coffee at world market price. The world market prices are converted into local currency at the government fixed exchange rate. But *no* tariffs on inputs or export duty on coffee, are subtracted.

Dynamic supply responsiveness: long-run factors

The additional 56,160 tons of marketable output cannot be produced from the existing farming systems whose medium yield is close to the current marketable output—around 150,000 tons. The first long-run goal, therefore, is to adopt new technology.

For example, to increase output up to 204,360 tons, Uganda would be producing 173,924 tons of clean robusta and 20,436 tons of clean arabica. This would require the adoption of advanced farming system IV in Table 6, to raise the yield to 5,000 kg/ha kiboko.

The producer's incentive to finance investment in new technology. To adopt the new technology requires *purchased inputs*: sprays, fertilizers, herbicides, and

insecticides, all of which are imported and in short supply on the open market. A major reorganization of input supply is required, involving regular foreign exchange allocation and competition between private and co-operative importers to ensure efficiency. The government, with its slow bureaucracy, would have to stay out of input supply. In the long-run, local manufacture of inputs would also have to be considered.

The new technology also requires *extension services* to develop the new high-yielding coffee clone, and disseminate information to the farmers regarding their husbandry. There is also the added opportunity cost of foregoing income up to 18 months before the new high-yielding coffee trees can come into full harvest.

A return to Table 6 shows that under the current pricing system, when the new technology is applied to bananas, the returns are USh 111,700 per hectare and USh 422 per man-day, while if applied to robusta, advanced farming system IV, the returns are only USh 91,474 per hectare and USh 152 per man-day. The current pricing system, therefore, offers no incentive to adopt new technology for coffee. Over 40 percent of the current trees are approaching the end of their productive life because of past neglect, and require replanting under the new technology.

There is a long-run evolving crisis in the coffee sector, therefore the pricing system offers no incentives to improve farming practices, yet yields under current practices are declining. The government has proposed subsidizing inputs to coffee farmers. But as long as bananas have higher returns, the subsidized inputs are likely to be diverted to bananas.

In the Ugandan context, the combined labour re-allocation crisis in the short-run, and the new technology crisis in the long-run, are serious. Cotton disappeared from the export sector due to poor policies; coffee might follow suit, but with more serious consequences as, then, the country would have *no* export base.

IV. Increasing coffee exports: The policy options

The purpose of Section IV is to estimate the exchange rate depreciation or export duty reduction required to realize a target increase in coffee exports, as follows:

1. The percentage of devaluation required; *or*

2. The percentage of reduction in export duty on coffee required to enable the Ugandan authorities to obtain a policy-determined target increase in foreign exchange earnings;

3. To assess whether the percentage in (1) is feasible, given the fact that inputs into industrial production are imported, and that the supply of import substitutes is relatively price inelastic, in which event a large percentage increase in their domestic price due to devaluation can be inflationary and stunt import substitution;

4. To assess further whether the percentage in (2) is feasible given that there are relatively few alternative sources of tax revenue.

The analysis in Section IV assumes that price changes due to devaluation are immediately passed on to the farmer in cash on delivering the crop, otherwise, the desired change in the quantity of coffee will not be forthcoming.

All coffee is assumed to be marketed through official channels: if some coffee is diverted from smuggling into official channels, this inflates the price elasticity of supply in Table 9, column (1), for example, and gives misleading results by reducing the required devaluation (see Section III(b) above).

The hypothetical calculations, for illustration, are presented in Table 9.

Table 9 The required percentage devaluation at different price elasticities of supply of coffee to effect an increase of 56,000 tons in coffee exports, 1988–1991

	The price elasticity of supply $\eta_{.i}$	Change in producer price dP_i	The producer price P_i for clean coffee	The exchange rate R_i	Change in the exchange rate dR_i (%)	The price P i for kiboko
	(1)	(2)	(3)	(4)	(5)	(6)
(1)	0.10	430	544	710	373	283
(2)	0.50	86	201	262	75	105
(3)	1.00	43	158	206	37	82
(4)	1.50	29	143	187	25	74
(5)	2.00	22	137	179	19	71

Notes:

Column (1) = the various values assumed for $\eta_{.}$

Columns (2) and (6) are in new Uganda shillings.

Column (6) is equal to column (3) times 0.52, to get the price of 1 kg of kiboko.

The devaluation problem: No change in export duty, Option No.1

Starting with exports of approximately 150,000 metric tons in 1987, the base year, the desired change in the quantity of coffee exports in order to reach the 5 percent ICO quota and to export to non-quota markets over five years is estimated to be:

(2) $dQ = Q_1 - Q_0 = 56{,}160$ tons, or approximately 56,000 tons

To find the required change in producer price to increase coffee exports by 56,000 tons (assuming no other bottlenecks), by definition:

(3) $$\eta = \frac{dQ}{dP}, \frac{P_0}{Q_0}$$

where η = the price elasticity of supply of coffee,

P_0 = the initial producer price of coffee, currently fixed at 60 new Uganda shillings per kilogram of kiboko or USh 115 per kg of clean coffee

Q_0 = the 1987 quantity of coffee exports, i.e. 150 thousand tons.

The price change required is:

$$(4) \quad dP = dQ \cdot \frac{P_0}{Q_0} \cdot \frac{1}{\eta}$$

Illustrative data in this section are calculated by assuming various values of η as: 0.10, 0.50, 1.00, 1.50, and 2.00. These cover the relevant range of available long-run price elasticities of supply in Table 1 above.

Once dP is obtained, for each value of η the devaluation required to effect dP can be estimated as:

(5) Let the new producer price be $P_1 = P_0 + dP$

R_O = new USh per US$ = 100 percent as the current exchange rate.

This R_0 is associated with a producer price of USh 60 per kg of kiboko, or USh 115 per kg of clean coffee = P_0.

The new producer price P_1 per kg will be associated (or feasible to pay) with a new exchange rate R_1 where:

$$(6) \quad R_1 = \frac{R_0 \times P_1}{P_0}$$

Equation (6) gives the new exchange rate in Uganda shillings per US$. The percentage depreciation required to pay the farmer P_1, will be:

$$(7) \quad \frac{R_1 - R_0}{P_0} \times 100$$

As the quantity supplied becomes more price elastic, increasing the value of η down column (1), the required rate of devaluation falls down column (5).

The very large and painful devaluations with adverse effects on import-substitution and domestic inflation are within the range of η = 0.10 to 0.50. Unfortunately, the discussion on the factors determining the price elasticity of supply in Section III suggest that Uganda's coffee supply is price inelastic, with η being within the range of 0.10 to 0.5, both in the short-run and in the long-run.

Devaluation alone, under the unchanged pricing structure and inefficient marketing system, is unlikely to attain the stated objectives of structural adjustment.

The reduction in export duty: No devaluation, Option No. 2

In the 1987/88 fiscal year, the export duty on coffee contributed USh 199,646 million to recurrent revenue, i.e. 34 percent.

At the official exchange rate of USh 150 per US$ and assuming an international price of coffee of US$ 2.00 per kg, which is the rough average of the recent past, the coffee producer has been receiving 37 percent of the world market price for clean coffee.

To raise this figure sufficiently to give a price which will induce producers to supply the target export volume of 56,000 tons, and assuming that transport, processing and marketing charges remain unchanged, the government will have to reduce its proportion of the international price. Table 10 illustrates the required reductions in the government's export duty at different price elasticities of supply, the resulting absolute revenue loss to government in Uganda shillings and the percentage of total recurrent revenue represented by this loss.

Take row (1), for example: the price increase constitutes 181 percent of the world price. An extra 81 percent of the world price would have to come from outside coffee to subsidize the USh 544 per kg. For a country in fiscal deficit, this is not feasible.

In column (5), the remaining proportion of the world price that would accrue to government in export duty, for rows (2, 5), is below the current 43 percent throughout.

In column (7), the absolute reductions in export duty (the last four entries) *are quite large* given that in 1986/87 fiscal year, Uganda derived USh 59,493 million from customs duty, USh 56,933 million from income tax, and USh 34,084 million from excise duty. The only other item next to the coffee export duty was the Commercial Transaction Levy which yielded close to USh 126,548 million in value.

Table 10 Data illustrating changes in export duty necessary to induce the producer to supply the target increase in quantity of coffee at various price elasticities of supply

	Price elasticity of supply	Desired producer price per kg clean (U Shs)	Column (2) as % of the world price at the official exchange rate	Remaining % of the world price after paying the producer	Remaining % of the world price after subtracting 20% for processing and marketing costs	% reduction in export duty, from 43%	Absolute reduction in export duty (new USh)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1)	0.10	544	181	−81	−101	−144	−287,490
(2)	0.50	201	67	33	13	−30	−59,897
(3)	1.00	158	53	47	27	−16	−31,943
(4)	1.50	143	48	52	32	−11	−21,961
(5)	2.00	137	46	54	34	−9	−17,968

Sources: Calculated from Table 9 above, columns (1), (2), and (3), and from data in Republic of Uganda, *Background to the Budget 1988–1989.*

Note: The negative signs in columns (4) and (5) show that when the price elasticity of supply lies within the range 0.10–0.50, it is impossible to reduce the export duty. In fact, a subsidy is needed to raise the producer price to Ug.Shs 544 in column (2), first entry.

V. Other important policy considerations

Comparative advantage and the domestic resource cost

In order to adopt the improved and advanced farming systems needed to increase output per hectare (Table 6), new technology must be introduced. This technology requires imported inputs such as sprays, fertilizers, insecticides, pesticides, and the breeding of high-yielding clones, etc.

An important policy consideration is whether, after importing the inputs, coffee still retains its comparative advantage as measured by the domestic resource cost indicator, or whether the production process becomes too import-intensive.

Let the domestic resource cost of the i^{th} commodity be defined by equation (8) as:

$$(8) \quad C_i = \frac{\sum_{j=1} V_j a_{ij}}{P_i^b - \sum_{j=1} N_j^b a_{ij}}$$

Where

C_i = the cost of the dollar earned or saved in producing the i^{th} commodity;

a_{ij} = the input requirements per unit of output of the i^{th} commodity, or the technology co-efficient;

V_j = value added, evaluated at accounting prices at a given stage of fabrication;

P_i^b = the border price of the i^{th} commodity;

N_j^b = value of imported inputs per unit of output of the i^{th} commodity.

When C_i is less than unity, there is comparative advantage in producing the i^{th} commodity, i.e. the value added evaluated at international prices c.i.f. in the denominator of equation (8) exceeds the factor cost in the numerator, i.e. production is efficient.

When equation (8) was applied to the 1986 data, the results shown in Table 11 were obtained:

Table 11 Domestic resources cost ratios of the i^{th} commodity

Robusta coffee	0.15	0.54
Arabica coffee	0.14	0.24

The range of values indicates computations under different assumptions. According to the results, the production of both kinds of coffee was efficient at the 1986 costs and prices.

It was not possible to gather 1989 data to update Table 11. However, it is generally believed that coffee production is efficient because Uganda has a favourable climate, labour is relatively cheap, and coffee fetches a high price on the international market.

In terms of adopting new technology, therefore, the use of imported inputs would not alter coffee's comparative advantage.

However, the assumption of cheap labour should be viewed with caution: the numerator in equation (8) is sensitive to the opportunity cost of labour in competing crops, e.g. bananas. Other things remaining equal, as the price of the competing crop increases, coffee loses its comparative advantage. Therefore, pricing policy is important for the export crop and for competing crops.[11]

The inflationary process and the Edwards/Fisher hypotheses

According to Sebastian Edwards (1985), basing his analysis on data from Columbia where coffee is a major export, an increase in the international price of coffee results in an appreciation of the real exchange rate, independently of what the domestic monetary authorities do.

The hypothesis works through two mechanisms: first, an increase in the price of coffee augments the country's foreign exchange reserves. The increase in reserves augments the monetary base and, unless *sterilized*, it leads to an expansion of the money supply, inflation, and real appreciation of the exchange rate. This is the "monetary effect" .

Second, an increase in the price of coffee, when passed on to the producers, raises disposable income, which leads to an increase in the demand for both tradeable and non-tradeable goods.

If the price of tradeables (non-coffee) goods is given by their world price and the exchange rate, the increase in disposable income, "the real income effect", results in higher relative prices of non-tradeables, and an appreciation of the real exchange rate.

Our preliminary reaction is that the "real income effect" is unlikely to work in Uganda because only 37 percent of the change in the international price of coffee is passed on to the producer, and even this is often paid late.

On the "monetary effect" there is a related hypothesis by R. Fisher (1985), that a *fall* in the international price of coffee leads to an *appreciation* of the real effective exchange rate (and symmetrically, a *rise* in the price would lead to a *depreciation).*

Fisher's transmission mechanism is through the fiscal budget: a *fall* in the international price of coffee, at a given exchange rate, lowers government's recurrent revenue since export duty on coffee constitutes around 50 percent of this revenue. To finance the budget, government borrows from the central bank, i.e. prints money, which results in domestic inflation and an appreciation of the real effective exchange rate.

Unless one argues that "do nothing" or "no sterilization" is also a policy, the conclusion from the Edwards/Fisher hypotheses on the "monetary effect", although working through different mechanisms, is that monetary authorities are unable to independently control domestic inflation. This conclusion is contrary to the monetarist models which argue that inflation is caused by the excessive expansion of domestic credit, which is within the control of governments in less developed countries.

The inflationary process and crop finance: a structuralist view

The Ugandan economy is characterized by a scarcity of commodities (especially consumer goods) and by a run-down industrial structure that cannot respond immediately to price incentives. Importation cannot increase the supply of goods because of the foreign-exchange constraint. Such an economy is prone to *structuralist inflation* due to domestic supply rigidities and a balance of payments constraint.

Within this setting, coffee purchased for cash *immediately* pumps additional purchasing power into the economy, while the increase in the supply of goods and services on which to spend this new purchasing power is *delayed* until the foreign exchange from exporting the coffee is received about four months later and is then allocated by the Bank of Uganda to prospective importers. In the meantime, the new purchasing power, chasing the few goods, bids up the price level, and starts the inflationary process.

To worsen the inflation, two other factors are at work: (a) part of the foreign exchange is used to pay international obligations and to service debt, so that even at the end of the delay the economy will not get enough imports to dampen the inflation; (b) very few local industries are capable of immediately responding to the increase in purchasing power because they too rely on imported inputs for raw materials and for rehabilitating their dilapidated plant and equipment.

A number of proposals have been suggested to combat structural inflation:

1. A system could be set up to order imports ahead of foreign exchange receipts. Unfortunately, this requires guarantee by the Central Bank, which is unlikely, given the scarcity of foreign exchange.

2. The procedure for foreign exchange allocation could be speeded up. Simultaneously, the CMB should speed up the realization of foreign exchange receipts. These administrative reforms would shorten the delay between increased purchasing power and the supply of imports.
3. A third proposal is to pay farmers through the banking system where payments can be tied either to saving schemes or to production credit, or both. If part of the new purchasing power is saved, or used to repay loans for inputs supplied on credit at the beginning of the crop season, the inflationary process would be reduced, especially since over 40 percent of broad money (M_2) is held as cash in the hands of the public who are chasing the few goods available.

   A common excuse is that there are too few banks in rural areas. However, the marketing co-operatives themselves could play the role of saving and credit institutions as they pay the farmer.
4. The fourth, and unfortunately, most commonly used proposal, is to pay farmers late. This has the detrimental consequences on producer incentives already discussed in Section III of this paper.

Whereas the structural problems await solutions, it is important to recognize that the government is unwilling to devalue since the positive effects of devaluation are very quickly eaten up by inflation, necessitating further devaluation.

The answer lies not in fixing a disequilibrium exchange rate (no devaluation), but instead in deliberate measures to change supply rigidities: e.g. exports' diversification to rapidly increase the supply of foreign exchange, grants and loans to purchase imported inputs for industry, etc. These measures should form an integral part of structural adjustment programmes.

The crop finance crisis and the efficiency of the marketing system

(a) A definition of crop finance

In Uganda, crop finance is part of working capital used to procure the crops from farmers and to finance stocks and processing activities in the marketing channel. It covers several crops: cotton, coffee, tea, tobacco and local produce such as maize, beans, etc. However, this paper concentrates on the coffee marketing system because it represents the greatest demand for crop finance.

(b) The magnitude of crop finance

On average, crop finance accounted for 45 percent of total commercial bank credit to the private sector over the years 1984–1987. The CMB is also an independent lender, and lately the Bank of Uganda is also directly paying some primary societies. This brings crop finance close to 50 percent of total bank credit. This magnitude of lending deprives other sectors of credit in an economy facing a credit squeeze because commercial banks are unable to mobilize 40 percent of the money supply held as cash by the public outside the banking system.

(c) Explanations of the large demand for crop finance

1. The length of the marketing channel

(a) The farmer sells coffee to primary co-operative societies, private buyers and processors: these need crop finance to pay the farmer.

(b) At the second level, crop finance is needed to finance stocks and primary processing by large societies with processing facilities, unions, and private processors. The processors sell to the CMB.

(c) At the third level, crop finance is needed to finance secondary processing and stocks at the CMB until the coffee is graded and loaded for export.

Had the buyers of the crop from the farmer been the processors and exporters, the funds needed to finance this shorter marketing chain would be minimized.

2. The efficiency of the users of crop finance

Table 12 shows the borrowers and lenders of crop finance

Table 12 Borrowers and lenders of crop finance

Borrowers	Lenders					
	UCB	Consortium of banks	Co-op Bank	CMB	Co-op unions	Co-op societies
1. Members of co-op societies	X	X	X			X
2. Private growers	X	X		X		
3. Co-op societies without processing facilities					X	
4. Co-op unions grade A	X	X	X	X		
5. Co-op unions grades B,C and D				X		
6. Private processors	X	X	X	X		
CMB	X	X				

Source: Agricultural Secretariat, Bank of Uganda, Coffee Farming Systems Development Report, August 1988.

Note: The consortium of banks includes: Barclays Bank, Standard Chartered Bank, Bank of Baroda, Libyan Arab-Uganda Bank, and Grindlays Bank. UCB and the Co-operatives Bank are outside the consortium.

This outlay is a result of various reforms which graded the co-operative societies and unions: those who are not credit worthy (e.g. co-operative societies and co-operative unions grades B, C and D) have their crop finance loans directly from,

or guaranteed by, CMB and cannot borrow from banks directly. The persistence of these customers in the marketing system is an anomaly since crop finance lent to them is not tied to any efficiency criteria such as stock turnover, capacity utilization of processing facilities (hullers), updated accounts, etc. Together these customers project a poor image of the performance of the co-operative sector compared to the private processors (Tables 13 and 14).

It would have been optimal to let these categories go bankrupt, but the co-operative sector is run as a parastatal, tightly controlled by government which often appoints or approves the appointment of the secretary manager, chief accountants, etc., on political rather than professional grounds.

Table 13 Comparative efficiency of unions versus private processors as indicated by turnover of crop finance (number of times per year)

Year	Private processors	Unions
1984/85	10.7	7.05
1985/86	10.7	4.62
1986/87	5.00	1.75
1987/88	8.90	1.95

Source: Agricultural Secretariat, Bank of Uganda, 1989.

Note: A higher or more frequent turnover minimizes the demand for crop finance as stocks move more rapidly through the marketing chain.

Table 14 Comparative processing efficiency

	Average of unions used in the price structure		Private processors
Efficiency parameters	October 1987	May 1988	May 1988
Average no. of hullers	2	2	2
No. of shifts per huller	1	1	1
Production days per year	180	210	210
Production per huller (metric tons per day)	3	3.5	4
Production per year (metric tons)	1,080	1,470	3,360

Source: Agricultural Secretariat, Bank of Uganda.

The same customers have less incentive to use their own funds to minimize the demand for crop finance because they persistently run at a loss.

Some crop finance is diverted to other uses. A notorious example is Banyankole Kweterana Growers Co-operative Union which used crop finance to

fund a large variety of inefficiently run businesses: livestock, consumer shops, a Caltex petroleum station, produce purchases, etc. These businesses proved to be loopholes for diverting crop finance to the benefit of top management, while the farmers were being paid late.

3. The CMB as monopoly exporter and as a financial intermediary

A common complaint is that the CMB has no export drive. It practically confines exports to quota markets and even then takes up to four months to claim export receipts, a delay that is partly responsible for inflation.

Table 3, column (3) showed that to increase foreign exchange earnings Uganda must sell surplus coffee, about a quarter of annual output, to non-quota markets: stocking this coffee leads to quality deterioration and ties up crop finance.

Recently coffee is being shipped for barter where it is under priced. Bartered coffee is paid for by cash in local currency, but the government ministries that receive the bartered goods still delay in making payments to CMB: this also increases the demand for crop finance.

As a financial intermediary, the CMB lending accounted for 8 percent of total commercial bank credit in 1987. About 70 percent of the loans went to co-operative societies and unions in categories 3 and 5 of Table 12, and were used inefficiently or diverted to non-coffee activities. The remaining 30 percent of loans went to the Produce Marketing Board (PMB), Lint Marketing Board (LMB), and the Ministry of Finance as advances in lieu of tax collection. According to Harvey "Essentially, a large part of the economy's financial intermediation has been performed by an institution wholly unequipped to do so".[12]

4. The Ministry of Co-operatives and Marketing

The Ministry is in charge of the co-operative movement within which coffee marketing co-operatives predominate. Co-operatives were started to organize smallholder farmers to cut out middlemen in processing and marketing so that these farmers would reap greater benefits. Co-operatives were also to be the main vehicle for implementing agricultural policy. The Department of Co-operative Development was to train skilled personnel to assist co-operators, and to supervise co-operative activities to ensure fairness.

The Marketing Boards are also administered by the Ministry. The CMB and LMB were started to run stabilization funds in the 1950s for coffee and cotton by paying higher producer prices to farmers when the world price fell, and paying lower producer prices when the world price rose, keeping the difference in the stabilization fund. With the secular decline in world prices, the funds could not be sustained: the savings accumulated earlier were used to build infrastructure, e.g. the Owen Falls Dam, and to start import-substitution industries, e.g. Nytil Textiles. Currently both CMB and LMB are sole monopoly exporters, collecting foreign exchange and export duty for government, albeit inefficiently.

The PMB was started to buy local produce in surplus periods and to sell during scarcity to stabilize prices. More recently, the PMB has been charged with collecting non-traditional exports for barter. But the prices at which the crops are collected are too low compared to local market prices; collection is also inadequate and crops rot in rural areas while private marketers are prevented from moving the crops across district boundaries.

In performing their intended roles, both co-operatives and marketing boards have been subjected to excessive government interference which has sheltered inefficiency and corruption.

5. A suggested alternative marketing system

Many proposals today argue for pumping more crop finance into the marketing system. For example, in the current crop season, 1988/89, USh 11 billion was estimated as being required for crop-finance, assuming four times the current turnover. As stocks pile up, the required funding is now USh 16 billion: this is feeding an inefficient system with more funds.

Instead, the marketing boards should become skeletal, just to supervise quality and standards. They should relinquish their marketing monopoly because this bottles up the marketing chain.

The co-operative movement should run on autonomous business lines: the inefficient co-operatives should be allowed to go bankrupt; the co-operatives that survive should be reorganized more efficiently to buy and process crops and to directly export in competition with private enterprise, which should also be allowed to export. Coffee exports should first fill the quota; licences should be auctioned for surplus coffee to be sold under aggressive competition to non-quota markets. The Department of Co-operative Development should be reduced to having a regulative function only.[13]

With trimmed co-operatives and marketing boards, the Ministry of Co-operatives and Marketing would become redundant and should be abolished. Its regulatory functions should be re-organized as the Department of Co-operatives and Marketing within the Ministry of Agriculture, as it used to be in the 1960s. This simplified institutional reform would bring marketing close to the farmers and enable them to have a say in the process. Marketing competition would give the farmers a genuine alternative to sell for cash and export, and avoid delayed payments. Competition would also force the marketers to move stocks, use retained funds to minimize the interest cost of borrowing crop-finance, and shorten the marketing channel.

VI. Conclusions and suggestions for further research

The objectives of structural adjustment, especially depreciation of the exchange rate, were to increase foreign exchange earnings by stimulating the supply of coffee; to redistribute income in favour of the farmer, the export producer; and to provide a non-inflationary source of government revenue.

The price elasticity of supply was the major mechanism for transmission of incentives to the export producer in the form of a higher producer price in local currency, made possible by devaluation. For this incentive to work, however, the higher producer price must be passed on to the farmer promptly to induce him to increase the quantity of exports and thus foreign exchange earnings.

A major conclusion of this paper is that the inefficient marketing system of the CMB and the co-operatives blocked this incentive as the farmer is paid late—up to one year in some cases.

A related second conclusion is that the inefficient marketing system, by producing a lag between releasing cash into the economy for crop finance and increasing the supply of imports (both inputs and consumer goods), fueled inflation, which rapidly eroded the potential benefits of devaluation.

Reorganization of crop finance and the marketing merit a separate research paper.

Uganda is a one-export economy. The country depends on that one export for foreign exchange earnings and budgetary revenue in the form of an export duty. A pricing policy that extracts an excessive export duty on coffee reduces the proportion of the price payable to the farmer. To avoid the tax, the farmer re-allocates his resources away from coffee, a result contrary to the intended objectives of devaluation which are to raise government revenue and to redistribute income in favour of the farmer.

The interaction between pricing policy, budgetary revenue, income distribution and devaluation, needs further research. A related subject for research is exports diversification, to move the economy away from a single export.

An overall conclusion of this paper is that, whereas devaluation might be necessary to stimulate exports, by itself it is not sufficient. An optimal pricing policy administered through an efficient marketing system, taxation reforms, and exports diversification, appear equally necessary components of a successful adjustment programme.

Appendix A

Table A.1 Area planted to coffee ('000 ha)

Year	Robusta	Arabica	Total	Masaka Robusta
	(1)	(2)	(3)	(4)
1971	229	28	251	43.7
1972	228	29	257	42.8
1973	206	28	234	35.8
1974	192	30	222	29.7
1975	191	33	224	29.7
1976	191	33	224	29.8
1977	191	33	224	29.8
1978	191	33	224	30.0
1979	190	33	224	30.0
1980	191	33	224	34.2
1981	191	33	224	40.1
1982	191	33	224	41.8
1983	191	33	224	41.9
1984	191	33	225	42.0
1985	191.5	33	225	41.1
1986	191.7	33	224.7	42.6
1987	191.7	33	224.7	-

Sources: Bank of Uganda, Agricultural Secretariat, 1988 and author's fieldwork in Masaka, April 1987.

Table A.2 Estimated area, output and yield of coffee, 1986

	Robusta			Arabica[a]		
	Area (ha)	Output ('000 t)	Implied yield (kg/ha)	Area (ha)	Output ('000 t)	Implied yield (kg/ha)
Central						
Luwero	10,620	8,601	810			
Masaka	46,112	37,360	810			
Mubende	41,296	33,450	810			
Mukono	53,082	43,012	810			
Rakai	5,764	4,670	810			
Mpigi	15,930	12,901	810			
Sub-total	172,804	139,994	810			
Western						
Bundibugyo	1,600	1,295	810	860	392	456
Bushenyi	4,493	3,641	810	1,038	3,232	3,113[b]
Hoima	1,200	972	810	–	–	
Masindi	300	243	810	–	–	
Mbarara	5,184	4,201	810	1,250	568	454
Rukungiri	2,553	2,069	810	1,340	609	454
Kabale	422	342	810	560	255	455
Kabarole	1,104	295	810	450	205	455
Kasese	40	32	810	1,430	650	455
Sub-total	16,896	13,690	810	6,928	5,911	455
Eastern						
Jinja	2,200	1,783	810			
Iganga	1,400	1,134	810			
Kamuli	1,600	1,296	810			
Kapchorwa	–	–		3,638	1,653	454
Mbale	–	–		18,630	8,467	455
Tororo	100	81	810			
Sub-total	5,300	4,294	810	22,268	10,120	
Northern						
Arua				150	68	453
Nebbi				140	654	455
Moyo				10	5	500
Kitgum				10	5	500
Sub-total				1,610	732	455
Total	195,000	157,978		30,806	16,763	

Source: Ministry of Agriculture.

Notes: a. The area for Arabica is given as 33,000 ha, while additions show it is 30,806 ha and output as 16,763 t instead of 15,000 t.

b. The Arabica areas and output for Bushenyi are suspect. The reported yield of over six times that of other areas is not feasible.

Table A.3 Marketed output of coffee ('000 tons)[a]

Year	Robusta (1)	Arabica (2)	Total (3)	Masaka Robusta (4)[b]
1971	159	16	175	–
1972	162	21	183	–
1973	169	18	187	–
1974	182	18	200	111.6
1975	182	15	197	60.6
1976	123	14	137	63.4
1977	153	4	157	62.6
1978	119	2	121	57.2
1979	98	6	104	24.6
1980	130	5	135	39.0
1981	93	5	128 [c]	36.6
1982	152	14	175 [c]	38.8
1983	143	15	144 [c]	30.2
1984	129	10	133 [c]	42.0
1985	144	11	155	38.8
1986	133	9	142	34.2
1987	151	9	148 [c]	–

Sources: Bank of Uganda, Agricultural Secretariat, 1988 and author's fieldwork in Masaka District, April 1987.

Notes:

a. There are no data published on actual production per year. What is marketed includes production, stocks, and diversion from smuggling.

b. In column (4) data for the first entries are not available because most of the past records were destroyed during the war of 1979.

c. Figures in columns (1) and (2) do not add up to those in column (3) for these years. One suggested source of disagreement is estimation of smuggling. Earlier estimates of smuggling were revised several times and synchronized.

Table A.4 Real average producer price in Uganda cents per kilogram

	Year	Low income group cost of living index,1981=100	Robusta coffee	Arabica coffee	Plantains (bananas)
		(1)	(2)	(3)	(4)
	1967	1	88	–	52
	1968	1	88	–	56
	1969	1	106	–	52
	1970	1	109	446	122
	1971	2	60	223	43
	1972	2	60	223	46
	1973	2	60	224	34
	1974	3	42	149	57
	1975	4	63	111	50
	1976	6	42	98	--
	1977	11	32	77	--
	1978	48	7	21	--
	1979	55	13	27	15
	1980	97	7	15	9
	1981	100	35	66	7
	1982	115	43	81	5
	1983	153	66	102	12
	1984	217	61	99	33
	1985	380	81	54	25
	1986	1,451	59	117	26
	1987	4,326	55	98	21
January	1988	7,432	39	67	22
July	1988	14,590	41	69	14

Source: Bank of Uganda, Agricultural Secretariat, 1988

Note: The nominal producer prices are deflated by the low income group cost of living index, August 1981 = 100. The real producer price of bananas rose by 200% between 1981 and July 1988, and was paid in cash on delivering the crop.
The real Robusta coffee price rose by 87%, while that of Arabica rose by 3% over the same period. But these coffee prices were paid at least 3 months late on most occasions, and sometimes as late as one year.
When the rate of inflation is high (as shown by the cost of living index in column (1) of Table A.4), and farmers are paid late for coffee, plantains (bananas) appear more attractive to grow, even if they fetch a lower nominal producer price per kg.(see column (3) Table A.5).

Table A.5 Norminal average annual producer prices in Uganda cents per kilogram

	Year	Robusta coffee (1)	Arabica coffee (2)	Plantains (3)
	1967	88	374	52
	1968	88	380	56
	1969	106	442	52
	1970	109	446	122
	1971	119	446	86
	1972	119	446	92
	1973	119	448	68
	1974	125	448	172
	1975	250	455	200
	1976	250	586	–
	1977	350	850	–
	1978	350	1,000	–
	1979	700	1,500	825
	1980	700	1,500	910
	1981	3,500	6,500	714
	1982	5,000	9,300	626
	1983	10,000	15,500	1,892
	1984	13,000	21,000	7,170
	1985	47,000	31,000	14,300
	1986	85,000	169,200	37,100
	1987	240,000	437,000	90,900
January	1988	290,000	500,000	166,000
July	1988	600,000	1,000,000	209,000

Source: Agricultural Secretariat, Bank of Uganda and Republic of Uganda, *Background to the Budget 1988/1989* (Kampala: Ministry of Planning and Economic Development).

Table A.6 Number of coffee processing factories by District and by owner, 1986/87 season

District	Number of factories				Number of licenced factories			
	(1) Unions	(2) Societies	(3) Private	(4) Total	(5) Unions	(6) Societies	(7) Private	(8) Total
Mukono	10	13	46	69	..	12	36	48
Mpigi	4	17	39	60	3	8	23	34
Masaka	5	10	24	39	..	5	22	27
Rakai	..	9	8	17	..	4	4	8
Mubende	4	5	19	28	..	6	11	17
Luwero	2	1	14	17	..	..	15	15
Mbarara	3	5	..	8	..	3	..	3
Rukungiri	1	6	1	8	1	3	1	5
Bushenyi	2	5	4	11	1	4	4	9
Hoima	3	..	..	3	2	..	1	3
Jinja	1	..	..	1	..	..	..	0
Iganga	2	..	1	3	..	..	1	1
Kamuli	1	..	1	2	..	..	1	1
Kampala	1	1	3	5	1	1	5	7
Kasese	2	..	..	2	..	..	..	0
Kabalore	..	1	..	1	..	1	..	1
Bundibugyo	1	..	..	1	..	..	..	0
Kabale	.	..	1	1	..	..	..	0
Mbale	1	..	..	2	..	..	1	1
Nebbi	1	...	..	1	..	..		0
Tororo	..	..	1	1	..	..	1	1
Total for 20 Districts	44	73	163	280	8	47	126	181

Source: Ministry of Co-operatives and Marketing.

Table A.7 Coffee processing facilities by District and by sales to CMB, season 1986/87

District	Sales of coffee to CMB (metric tons)	% of total coffee sales to CMB	Total factories	Total hullers	Coffee per factory	Factories delivering 100 metric tons	Factories delivering 500 metric tons
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mukono	49,945	32	69	119	819	6	25
Mpigi	19,436	12	60	93	381	16	38
Masaka	13,557[a]	11	39	77	533[b]	4	24
Mubende	15,527	10	28	52	706	5	12
Luwero	11,910	8	17	39	794	4	9
Mbale	7,558	5	2	0	7,588[b]	..	..
Rakai	6,815	4	17	32	487–	3	9
Iganga	5,984	4	3	11	1,995	1	2
Bushenyi	5,331	3	11	17	533–	3	8
Mbarara	4,778	3	8	17	597	1	5
Jinja	4,308	3	1	6	4,308	..	..
Hoima	3,016	2	3	8	1,005	..	1
Rukungiri	1,921	1	8	10	274–	3	6
Kasese	1,615	1	2	6	840	..	..
Kampala	1,625	1	5	11	542	..	2
Kamuli	784	..	2	1	784	..	..
Bundibugyo	162	x	1	2	162	..	1
Kabarole	124	x	1	2	124	..	1
Kabale	20	x	1	2	20	1	1
Nebbi	24	x	1	4	24	1	1
Total			280	509	633[c]	48	145

Source: Ministry of Co-operatives and Marketing and Coffee Marketing Board, 1987.

Notes: a. Deliveries to Masaka include 4,029 tonnes directly purchased by CMB but processed in the District.

b. = Too few factories, relative to sales from the District.

c. As provided by district breakdown from MCM after adding in approximately 400 tonnes from CMB direct buying, the resulting total being 160,000 tonnes. Exact figures for MCM = 4,029 tonnes, CMB buying 39 and other sources NRA, Customs, etc.
x = Less than 0.05%.
– = Too many factories, relative to sales from the district.

Table A.8 Revenue from improved husbandry to maximize output per hectare of Robusta coffee per growing season in Kibinge-Masaka, and the cost for each activity

	Activity		Cost (New USh)
1.	Proper weeding by hoe		500
2.	Pruning		500
3.	Mulching (to reduce weeding and soil leaching from rains. This activity is labour intensive.)		5,000
4.	Fertilizer application, e.g. sulphate of ammonia nitrate		4,000
5.	Spraying with insecticides		4,000
6.	Harvesting, by hand-picking		500
7.	Transportation by bicycle		500
8.	Total cost of improved husbandry per hectare per growing season		15,000
9.	Total revenue per hectare yielding 3,000 kg, per season, at official price of new USh 24/kg	=	72,000
10.	Net revenue to the farmer per season		57,000

Source: Author's field work, April 1987, compiled with the assistance of the Agriculture Officer in the area.

Appendix B

I. Methodology for estimating coffee supply elasticities

The producer's optimization function: A problem in capital theory

Given that coffee is a perennial tree crop that bears fruit for over 100 years, the producer regards the amount of his resources employed in coffee production as a problem in capital theory. He seeks to maximize the total capitalized present value of a stream of discounted future profits (i.e. revenue minus costs).

$$\eta = P.Q - WL - sI$$

where
- P = real producer price
- Q = quantity of coffee marketed
- W = real farm wage rate
- L = quantity of labour employed
- I = gross rate of planting per year
- S = price of a hectare of land.

The integral the farmer seeks to maximize is:

$$(1) \qquad v = \int_{\circ}^{\infty} e^{-rt} [\bar{\eta}(t)]\, dt$$

subject to the following two constraints:

$$Q = (L,X) = \text{the production function}$$

$$\frac{dx}{dt} = 1 - \sigma x$$

where
- V = the present value
- X = acreage under coffee in hectares
- $\frac{dX}{dt}$ = the rate of change of acreage with respect to time
- r = the discount rate.

The production function meets the neo-classical criteria where:

$$\frac{\partial Q}{\partial X} > 0, \quad \frac{\partial Q}{\partial L} > 0$$

The marginal product of each factor is positive;

$$\frac{\partial^2 Q}{\partial X^2} < 0, \frac{\partial^2 Q}{\partial L^2} < 0$$

The marginal products decrease: $\frac{dX}{dt}$ states that the rate of increase of coffee acreage equals gross planting less replanting (or abandonment), i.e. for X we are concerned with the hectares of mature coffee-bearing trees only. To maximize (1), subject to the two constraints, we maximize the following Lagrangian function as:

$$V = \int_0^\infty \left\{ e^{-rt} [\bar{\eta}(t)] + \lambda_0(t)[Q - Q(L_1 X)] + \lambda_1(t)[X - I + \sigma X] \right\} dt$$

$$V = \int_0^\infty F(t)\, dt$$

where $F(t) = e^{rt}[P.Q - WL - sI\} + \lambda_0(t)[Q - Q(L_1 X) + \lambda_1(t)[X - 1 + \sigma x]$

Euler's necessary conditions for a maximum are:

(2) $$\frac{\partial F}{\partial Q} = e^{-rt} p + \lambda_0(t) = 0$$

(3) $$\frac{\partial F}{\partial Q} = -e^{-rt} w - \lambda_0(t)\frac{dQ}{dL} = 0$$

(4) $$\frac{F}{\partial I} = -e^{-rt} s - \lambda_1(t) = 0$$

(5) $$\frac{\partial F}{\partial X} - \frac{d}{dt}\frac{\partial F}{\partial X} = -\lambda_0(t)\frac{\partial Q}{\partial X} + \lambda_1(t)\sigma - \frac{d}{dt}\lambda_1(t)$$

(6) $$\frac{\partial F}{\partial \lambda_0} = Q - Q(L_1 X) = 0$$

(7) $$\frac{\partial F}{\partial \lambda_1} = \frac{dX}{dt} - I + X\sigma = 0$$

using (2), $\lambda_0 (t) = -e^{-rt} p$

substitute for $\lambda_0 (t)$ into equation (3):

$$e^{-rt} \frac{P\partial Q}{\partial L} = e^{-rt} w$$

$$(8) \quad \frac{\partial Q}{\partial L} = \frac{W}{P}$$

The marginal product of labour equals the wage rate/price ratio.

In equation (4) $\lambda_1 (t) = -e^{-rt} s$ substituting for $\lambda_0 (t)$ and $\lambda_1 (t)$ into (5) we get:

$$e^{-rt} P \frac{\partial Q}{\partial X} - e^{-rt} s\sigma \frac{d}{dt}[-e^{-rt} s] = 0$$

$$e^{-rt} P \frac{\partial Q}{\partial X} = e^{-rt} s\sigma + re^{-rt} s$$

$$(9) \quad \frac{\partial Q}{\partial X} = \frac{e^{-rt} s(\sigma + r)}{e^{-rt} P} = \frac{s(\sigma + r)}{P} = \frac{c}{P}$$

i.e. the marginal product of land equals the implicit rental of land/price ratio.

c = the implicit rental of land or user cost.

The coffee producer's optimization problem in capital theory has so far been given a standard economic interpretation where he was seen to have maximized a constrained profit function, and in equilibrium, the marginal product of each factor he employed was equated to the price/ cost ratio.[1]

2. The determinants of land productivity

To achieve a pre-determined target level of output, e.g. 56,160 tonnes, increase in the quantity of coffee to fill the CIO quota by the year 1991, Ugandan policy makers should be interested in what determines output per hectare, or the land productivity which is necessary, so as to maximize the quantity of coffee supplied to official channels over the given period, designated Q in our analysis. Let

(10) $Q = Y[k(\ )x^{-\alpha} + (1-K)(R)L^{-\alpha}]^{v/\alpha}$

be the augmented production function where:

- Y = y(t) = the scale parameter denoting technological progress,
- k = the distribution parameter determining the division of income to be imputed to each factor of production,
- v = the degree of homogeneity of the production function,
- α = the substitution parameter between factors of production
- R = the weather parameter, assumed to be a factor augmenting and Hicksian "neutral" with respect to each factor of production.

Also let σ = the elasticity of substitution related to α as

$$\sigma = \frac{1}{1+\alpha} \text{ or } \alpha = \frac{1}{\sigma} - 1$$

To derive the productivity per hectare equation to be estimated empirically, let

(11) $$\frac{\partial Q}{\partial X} = \frac{dQ}{dZ} \cdot \frac{\partial Z}{\partial X}$$

where Z is set as

$$Z = [k(R)x^{-\alpha} + 1\text{-}k(R)^{-\alpha}]$$

$$Q = YZ^{-v/\alpha}$$

$$\frac{dQ}{dz} = (Y)(-v/\alpha)Z^{-v/\alpha-1}$$

$$\frac{\partial Z}{\partial X} = (k)(-\alpha)(R)x^{-\alpha-1}$$

From equation (11), and substituting for Z

(12) $$\frac{\partial Q}{\partial X} = (Y)(-v/\alpha)[k(R)x^{-\alpha} + (1-k)(R)L^{-\alpha}]^{-v/\alpha-1}(K)(-\alpha)(R)X^{-\alpha-1}$$

collecting terms:

$$(13)\quad \frac{\partial Q}{\partial X} = Yvk(R)X^{-\alpha-1}\left[k(R)X^{-\alpha} + (1-k(R)L^{-\alpha}\right]^{-v/\alpha-1}$$

To define output per hectare in terms of land and weather alone, return to equation (10), and re-writing it as

$$\left(\frac{Q}{Y}\right)^{-a/v} = k\ (R)x^{-\alpha} + (1-k)(R)L^{-\alpha}$$

it follows that:

$$\left(\frac{Q}{Y}\right)^{-\alpha/v} - k(R)X^{-\alpha} = (1-k)(R)L^{-\alpha}$$

$$L^{-\alpha} = \frac{\left(\frac{Q}{Y}\right)^{-\alpha/v} - k(R)x^{-\alpha}}{(1-k)(R)}$$

substituting for $L^{-\alpha}$ into the second term in brackets of equation (13), we have:

$$\frac{(1-k)(R)\left[\left(\frac{Q}{Y}\right)^{-\alpha/v} - k(R)X^{-\alpha}\right]}{(1-k)(R)} = \frac{(Q)^{-\alpha/v}}{Y} - k(R)X^{-\alpha}$$

Then equation (13) can be rewritten as

$$\frac{\partial Q}{\partial X} = Yvk(R)x^{-\alpha-1}\left[k(R)x^{-\alpha} + \left(\frac{Q}{Y}\right)^{-\alpha/v} - k\ (R)x^{-\alpha}\right]^{-v/\alpha-1}$$

$$\frac{\partial Q}{\partial X} = Yvk(R)x^{-\alpha-1}\left[\left(\frac{Q}{Y}\right)^{-\alpha/v}\right]^{-v/\alpha-1}$$

simplifying and equating to equation (9)

$$(14)\quad \frac{\partial Q}{\partial X} = Yvk(R)x^{-\alpha-1}\left(\frac{Q}{Y}\right)^{(v+\alpha)} = \frac{c}{p}$$

From equation (14) if we arrange terms, we have:

$$\frac{\partial Q}{\partial X} = Rkvx^{-\alpha-1}\ Q^{1+\frac{\alpha}{v}}\ Y^{1}\ Y^{-(v+\alpha)} = \frac{c}{p}$$

(15) $$\frac{Q}{\partial X} = Rkvx^{-\alpha-1}\, Q^{(1+\alpha/v)}\, Y^{(-\alpha/v)} = \frac{c}{p}$$

If each term in equation (15) is multiplied by a power factor of $-\left(\frac{1}{1+\alpha}\right)$, we get:

(16) $$\left(\frac{\partial Q}{\partial X}\right)^{-\left(\frac{1}{1+\alpha}\right)} = kvR^{-\left(\frac{1}{1+\alpha}\right)} \times Q^{(1+\alpha/v)^{-\left(\frac{1}{1+\alpha}\right)}} Y^{(-\alpha/v)^{-\left(\frac{1}{1+\alpha}\right)}} = \frac{(c)^{-\left(\frac{1}{1+\alpha}\right)}}{p}$$

given that $\sigma = \frac{1}{1+\alpha}$ is defined as the elasticity of substitution from which

$$\alpha = \frac{1}{\sigma} - 1$$

equation (16) can be rewritten as

(17) $$\left(\frac{Q}{\partial X}\right)^{-\sigma} = (kvR)^{-\sigma} XQ^{(1+\alpha/v)^{-\sigma}} Y^{(\alpha/v)^{\sigma}} = \left(\frac{c}{p}\right)^{-\sigma}$$

now $$1+\frac{\alpha}{v} = 1+\left(\frac{1}{\sigma} - 1\right)\frac{1}{v} = 1+\frac{1}{\sigma v} - \frac{1}{v}$$

$$= \frac{\sigma v + 1 - \sigma}{\sigma v}$$

Also $$\frac{(\alpha)}{v}\sigma = -\left(1 - \frac{1}{\sigma}\right)\frac{\sigma}{v} = \left(\frac{\sigma-1}{v}\right) = \frac{1-\sigma}{v}$$

now the right hand side of (17) becomes

(18) $$kvR^{-\sigma}\, Q^{\frac{(v\sigma+1-\sigma)}{v}}\, Y^{\frac{(1-\sigma)}{v}}\, x = \frac{(c)^{-\sigma}}{p}$$

If we take logs of equation (18) we have

(19) $$\left[-\sigma \log(kvR) + \frac{(-v\sigma+1-\sigma)}{v}\log Q + \frac{(1-\sigma)}{v}\log Y + \log X\right] = -\sigma \log\left(\frac{c}{p}\right)$$

now (19) can be rearranged as follows:

let $$A = -\sigma \log(kvR) + \frac{1-\sigma}{v}\log Y$$

$$(20) \quad -\log X = A - \frac{(v\sigma + 1-\sigma)}{v} \log Q + \sigma \log\left(\frac{c}{p}\right)$$

If we add log Q to both sides of equation (20) we get

$$(21) \quad \log Q - \log X = A - \frac{(v\sigma + 1-\sigma)}{v} \log Q + \sigma \log\left(\frac{c}{p}\right)$$

$$(22) \quad \text{or} \log\left(\frac{Q}{X}\right) = A + \frac{(v-v\sigma+1-\sigma)}{v} \log Q + \sigma \log\left(\frac{c}{p}\right)$$

This (22) is the output per hectare or productivity equation which Maitha used to estimate the elasticities of coffee supply in Kenya.[2] We need data on Q and X to estimate (22) which is not available. Data on X in Table A.1 are simply an extrapolation.

Notes to Appendix B

1. This standard interpretation was followed by Maitha (1974). studying Kenyan coffee supply.
2. Maitha's simplification procedure differs markedly from ours, however. This is why we spelt out ours in detail. His final result is $\log (Q/x) = A + \sigma (1 - \alpha/v) \log Q + \sigma \log \left(\frac{c}{p}\right)$ (9b) (Maitha, 1974). For the simplification procedure see pp. 49–51 and the final result is equation (9b) of Maitha's own procedure in his work, which we disagree with.

Appendix C

The problem of substitute crops

Existing studies, including that of Maitha, assume that coffee is grown in pure stands so that if all suitable arable land is already planted, variation in own-producer price of coffee, and the existing stock not sold the previous year (Z_{t-1}), are the only influences on output per hectare.

In Uganda, inter-planting by smallholders who grow over 90 percent of the coffee is the norm, however. Coffee is inter-planted with beans, maize, bananas, etc.

The prices of food crops are not controlled but vary with demand and supply conditions in the market, and with the rate of inflation. Price changes in the substitute crops which compete directly with coffee for the producer's indentical resources lead to:

(a) Either neglect (poor husbandry) of coffee trees, and a decline in marketed output; or

(b) Improvement in husbandry, thus raising coffee output (i.e. when the relative prices of the substitutes are below that of coffee).

Let *nt* = the fraction of neglected plants, or the extent of neglect per hectare that reduces marketed output.

Let *bt* = the extent of better husbandry in year t that is reflected in increased output.

Let *nt* and *bt* effects be due to price changes alone, unrelated to the historical trend in technology improvement.

When the real producer price declines, relative to the real market prices of substitutes, this leads to improved husbandry, and output for the year becomes

(23) $Q't = (1 + bt)\, Qt$

When the real producer price declines, relative to the real market prices of substitutes, poor husbandry is reflected in a decline in output as

(24) $Q't = (1 - nt)\, Qt$

Now, since events (23) and (24) are mutually exclusive, only one of them can be observed in year *t*.

Combining equations (23) and (24)

$Q = (1\text{-}nt) \cdot (1+bt)\ Qt$ is the modified output in year *t* after taking into account the effects of substitute crops' market prices.

$\log Q = \log [(1\text{-}nt)(1+bt)] + \log Qt$

$\log (Q/X) = \log [(1\text{-}nt)(1+bt)] + \log Qt - \log X$

Let $\log (Q/X)\ t$ = the log of output per hectare in year *t* where *X* itself can vary from year to year, while

$\log (Q/X)$ = the actual log of output per hectare observed in a particular year when *X* itself needs not vary. But since it is the observed term that is relevant for policy, it can be equated to $\log (Q/X)t$.

Let us rewrite equation (22) as:

$$(25)\quad \log(Q/X)t = A - \frac{(v - v\sigma + 1 - \sigma)}{v}[\log(1 - nt)(1 + bt) + \log Qt] + \sigma \log\left(\frac{c}{p}\right)$$

Let $M = (1\text{-}nt)(1+bt)$

$$(26)\quad \text{Then } \log (Q/X)\ t = A + \frac{(v - v\sigma + 1 - \sigma)}{v}(\log M + \log Qt) + \sigma \log\left(\frac{c}{p}\right)$$

This is defined as:

$$(27)\quad \log (Q/x)\ t = A + \frac{(v + 1 - \sigma v - \sigma)}{v}(\log M) + \left(\frac{v + 1 - \sigma v - \sigma}{v}\right)\log Qt + \sigma \log\left(\frac{c}{p}\right)$$

$a_0 \qquad a_1 \qquad a_2 \qquad a_3$

Equation (27), productivity per hectare, can be estimated statistically where:

a_0 = the historical constant reflecting past historical influence and weather;

a_1 = the coefficient of the variation in output per hectare due to the relative real market prices of substitute food crops. Data to estimate this coefficient (variation in coffee output alone) are derived (illustration only) in section 4 below.

a_2 = the coefficient of the variation in output per hectare due to existing stock in year *t* of unsold coffee from previous output.

a_3 = the coefficient of the variation in output per hectare due to the land-rental price ratio. Since all suitable arable land for coffee is already planted, this coefficient depends on own real producer price alone, as *c* becomes only relevant when there is a decision to expand acreage, which is negligible in Uganda. The price term follows the expected value lag structure discussed by Nerlove (1956).

Suppose the data on Qt for a certain coffee-growing area during the years 1981/1987, were as shown below (assuming that coffee is interplanted with a substitute crop)

Year	Quantity of coffee Qt (hypothetical data)
1981	150
1982	200
1983	180
1984	135
1985	160
1986	190
1987	195

The values of *nt* and *bt* for year *t* can be calculated as follows:

$$n\,t = \frac{Qt - Qt + 1}{Qt} \text{ and } b\,t = \frac{Qt + 1 - Qt}{Qt}$$

and in any given year only one of the fractions nt or bt applies since events (1-nt) and (1+b are mutually exclusive, i.e. better husbandry and neglect are mutually exclusive.

We could not run equation (27). althopugh it has the advantage that only data on Qt are needed, the data available were on "marked output", while Qt refers to real output from the field.

Appendix D

Variation in labour productivity

It has been argued that for an already planted shamba, short-run variations in output are due more to variations in labour productivity (better weeding, pruning, mulching, etc.), than to variation in land productivity (which only long-run inputs such as application of fertilizers can change).

To estimate the change in labour productivity, the procedure is as follows:

$$Q = Y[(K/R)\, x^{-\alpha} + (1-K)(R)\, L^{-\alpha}]^{-v/\alpha}$$

$$Z = K(R)\, x^{-\alpha} + (1 - k)(R)\, L^{-\alpha}$$

$$Q = YZ^{-v/\alpha}$$

$$\frac{dQ}{dL} = \frac{dQ}{dz} \cdot \frac{dz}{DL}$$

$$\frac{dQ}{dz} = Y^{-v/\alpha} \,.\, Z^{(-v/\alpha - 1)}$$

$$\frac{dZ}{dL} = (1 - k)\, R^{-\alpha} \,.\, L^{(-\alpha-1)}$$

$$= (1 - K) \,.\, L^{-\alpha-1} \,.\, Y. V. Z^{(-v/\alpha-1)}$$

substituting for Z

$$\frac{dQ}{dL} = (1 - k)\, R.L^{-\alpha - 1} \,.\, Y \,.\, v\, [K(R)\, x^{-\alpha} + (1 - K)\, R \,.\, L^{-\alpha}]^{-v/\alpha-1}$$

(28) Therefore $$\frac{dQ}{dL} = (1 - K)\, R.L^{(-\alpha-1)} \,.\, Y.v\, [K(R)\, x^{-\alpha} + (1 - K)\, R.L^{-\alpha}]^{-v/\alpha-1}$$

From equation (10)

$$\left(\frac{Q}{Y}\right)^{-\alpha/v} = K\,.\,(R)\,x^{-\alpha} + (1-K)(R)\,.\,L^{-\alpha}$$

$$x^{-\alpha} = \frac{\frac{Q^{-\alpha/v}}{Y} - (1-K)(R).L^{-\alpha}}{K(R)}$$

From equation (23)

$$K(R)^{x-\alpha} = K(R)\frac{\left[\frac{Q^{-\alpha/v}}{Y} - (1\,K)(R)\,.\,L^{-\alpha}\right]}{K(R)}$$

and equation (23) becomes

$$\frac{dQ}{dL} = (1-K)(R)L^{-\alpha-1}\,.\,Y.v\left[\frac{Q^{-\alpha/v}}{Y}(1-K)(R)L^{-\alpha} + (1-K)(R)L^{-\alpha}\right]^{-\alpha/v-1}$$

$$= (1-K)(R)L^{-\alpha-1}\,.Y.v.\left[\frac{Q^{-\alpha/v}}{Y}\right]^{-\alpha/v-1}$$

$$= (1-K)(R)L^{-\alpha-1}\,Y.v\left(\frac{Q}{Y}\right)^{1+\alpha/v} = \frac{w}{p}$$

$$= (1-K)(R)L^{-\alpha-1}\,.V.Y.Y^{-(1+\alpha/v)}Q^{1+\alpha/v} = \frac{w}{p}$$

$$= (1-K)(R)L^{-\alpha-1}\,V.\frac{Y}{Y},\,Y^{-\alpha/v}\,Q^{1+\alpha/v} = \frac{w}{p}$$

(29) $$\frac{dQ}{dL} = (1-K)(R)L^{-\alpha-1}\,v\,Y - \alpha/v\,Q^{(1+\alpha/v)} + \alpha/v = \frac{w}{p}$$

$$\frac{(dQ)^{\frac{-\sigma}{\alpha+1}}}{dL} = 1 - kvR^{\frac{-\sigma}{\alpha+1}} + L^{(-\alpha+1)\frac{(-\sigma)}{\alpha+1}} + Q^{(1+\alpha/v)\frac{(-\sigma)}{\alpha+1}} + Y^{\frac{-\alpha}{v}\frac{(-1)}{\alpha+v}} = \frac{(w)^{\frac{-\sigma}{\alpha+1}}}{P}$$

(30) $$\frac{(dQ)^{-\sigma}}{dL^{\alpha+1}} = (1-K)\,.\,V\,R^{\frac{-\sigma}{\alpha+1}}\,L\,.\,Q^{\frac{(1+\alpha)}{v}\frac{-\sigma}{\alpha+1}}\,.\,Y^{\frac{-\alpha}{-v}\left(\frac{-\sigma}{\alpha+1}\right)} = \left(\frac{w}{P}\right)^{\frac{-\sigma}{\alpha+1}}$$

given that $\sigma = \frac{1}{1+\alpha}$ is defined as the elasticity of substitution;

from which $\alpha = \frac{1}{\sigma} - 1$

equation (29) can be re-written as:

$$\frac{(dQ)^{-\sigma}}{dL} = (1 - K)\, V\, .\, R^{-\alpha}\, .\, L\, .\, Q^{(1+\alpha/v)-\sigma}\, .\, Y^{\frac{-\alpha}{v}\sigma}$$

Now

$$1 + \frac{\alpha}{v} = 1 + \left(\frac{1}{\sigma} - 1\right)^{\frac{1}{v}} = 1 + \frac{1}{\sigma v} - \frac{1}{v}$$

$$= \frac{\sigma_v + 1 - \sigma}{\sigma_v}$$

$$\text{also } \frac{(\alpha)}{v}\sigma = -\left(1 - \frac{1}{\sigma}\right)\frac{\sigma}{v} = -\frac{(\sigma-1)}{v} = \frac{1-\sigma}{v}$$

Now the right-hand side of equation (23) becomes:

$$(1\text{-}K)\, VR^{-\sigma}\, .Q\left(\frac{\sigma v+1-\sigma}{\sigma v}\right).Y\left(\frac{1-\sigma}{v}\right).L = \frac{w(-\sigma)}{P}$$

which equals

(31) $$(1\text{-}K)\, V\, R^{-\sigma}\, Q^{\frac{(\sigma v+1-\sigma)}{v}}.\, Y^{\frac{1-\sigma}{v}}.L = \left(\frac{w}{P}\right)^{-\sigma} = \frac{dQ}{dL}$$

If we take logs of equation (28)

(32) $$\log(1 - K)\, V\, R - \frac{(\sigma v + 1 - \sigma)}{v}\log Q + \frac{(1-\sigma)}{v}\log Y + \log L = -\sigma \log\left(\frac{w}{P}\right)$$

Now equation (30) can be rearranged as follows:

$$\text{Let } B = -\sigma \log(1\text{-}K)\, V.R + \frac{1-\sigma}{v}\log Y$$

(33) $$-\log L = B - \frac{(\sigma v + 1-\sigma)}{v}\log Q + \sigma \log\left(\frac{w}{P}\right)$$

(34) If we add log Q to both sides of equation (34)

$$\log Q - \log L = B - \frac{(\sigma v + 1-\sigma)}{v}\log Q + \log Q + \sigma \log\left(\frac{w}{p}\right)$$

$$= B + = \frac{(V + v\sigma + 1 - \sigma)}{v}\log Q + \sigma \log\left(\frac{w}{P}\right)$$

$$(35) \qquad \text{Log}\left(\frac{Q}{L}\right) = B + \frac{(v - v\sigma + 1 - \sigma)}{v} \log Q + \sigma \log\left(\frac{w}{P}\right)$$

Equation (35) is what we need to estimate the change in labour productivity.

Like the equations derived previously, equation (35) cannot be estimated because we lack data on Q real output from the field, on *(w)* the real wage, and L the man-days of labour.

Notes

1. A detailed methodology to derive the productivity equation (1) from the constant elasticity of substitution production function, and the capital theory model, is given in Appendix B, Section 1.
2. Two alternative derivations of equation (1) are given in appendix B, Sections 2 and 3. But these derivations cannot be empirically estimated either, until data becomes available.
3. The computations assumed that the farmer is paid the fixed price in cash on delivering the crop. Any late pay, which is frequent, further erodes the terms of trade against the farmer, below that of Table 5.
4. Tebaijuka and Mabele (1986).
5. See also Note 3 to Table A.3 in Appendix A.
6. See also the interpretation of the policy scenarios in Table 9 in Section 4.1 below.
7. For example, there was a 50% increase in coffee delivered to the Coffee Marketing Board, CMB, in the last quarter of 1987, a period of no fresh production since harvests are in December/January and May/June. This was attributed to diversion from smuggling (Harvey, 1988).
8. Crop Finance is discussed in Chapter V, third section.
9. There are allegations that some managers of unions open up private processing factories to which they divert union crop-finance funds, in which event the efficiency of private processors is over-stated.
10. The CMB is discussed further under crop-finance in Chapter V, third section.
11. See Agricultural Secretariat (1986), *The Use of the Domestic Resource Cost Method.*
12. *Harvey* (1988), p.24.
13. This view is emerging from the Ministry of Agriculture. See "CMB monopoly attacked" *New Vision* Vol. 4, No. 98, Sat. 13th May 1989.

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